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Globalization and the Intensification of Global Competition Seen in the IEEE: What Impact will International Mobility of Research Personnel have on R&D? Symposium Report

Minoru NOMURA
Affiliated Fellow

1 Symposium Overview

The National Institute of Science and Technology Policy's Science and Technology Foresight Center, in considering the international competitiveness of Japan in the future, chose IEEE (the Institute of Electrical and Electronics Engineering, Inc.), one of the largest international societies, as the target for a variety of analyses. The data acquired led to a number of discussions intended to help clarify the current circumstances surrounding engineering R&D both in Japan and around the world.[1] In March 2010, the first symposium was held, and discussions focused on the field specificity of Japanese R&D and the impact of human movement, among other things. This time, at the second symposium, we discussed in detail recent changes relating to the IEEE and analysis results on the international mobility of researchers. We also discussed their relationship and the impact they will have on the future.

This time, the Science and Technology Foresight Center announced that the symposium was to be divided into two halves. The first half consists of two presentations, (1) "The State of Japanese and Worldwide R&D as Inferred from Analyses of IEEE Conferences and Periodicals" and (2) "A Comparison of International Mobility of Researchers in Three Fields."

The second half of the symposium, based on the contents presented in the first half, featured a discussion involving all in attendance. In an attempt to keep the discussion lively, four commentators were established in hopes of focusing the comments received. Serving in the capacity of commentator from the perspectives of engineering research and university administration was Dr. Fumio Harashima (IEEE Life Fellow, President of Tokyo Metropolitan University). Serving from the perspectives of organizational management and abilities was Dr. Kiyonori Sakakibara (Professor, Hosei Graduate School of Innovation Management, Hosei University). Serving from the perspectives of international competitiveness of industry and its influence was Dr. Hiroyuki Chuma (Professor, Hitotsubashi Institute of Innovation). Finally, serving from the perspectives of the future possibilities of Asian scientific/technological innovations was Dr. Atsushi Sunami (Associate Professor, National Graduate Institute for Policy Studies). A total of 45 individuals participated in this symposium.

In the chapters below, chapter 2 summarizes the analysis results that were presented and exhibited during the first half of the symposium, while chapter 3 highlights the majority opinions from among the many opinions presented during the discussions in the second half of the symposium and concludes with perspectives on what should be studied in the future. Especially problematic data as well as all of the additional opinions raised will be published as an appendix to this document.

2 The Present State of Diversity and Mobility in Japanese Engineering R&D

2-1 Japan and Trends in World Research (Presentation 1)

First, a presentation on trends in world research and Japan's place within it was made based on reference data.[1] As mentioned above, a continuous literature survey was conducted targeting IEEE periodicals at the National Institute of Science and Technology Policy, and the reference data[1] becomes the third

of a series of reports. With the addition of new conferences/proceedings (international conference proceedings), this survey, which targets IEEE periodicals for analysis, produced and analyzed data from over 1.5 million pieces of engineering literature over a period of 30 years.

The main contents were as follows.

- It is clear that, in recent years, research has increased around the world, particular in the field of information and communications. As of yet, the United States is the country pioneering new fields of study and is the leader in world research. However, if judging only by conferences, China has been surging at an incredible pace, and as of 2008, the number of Chinese proceeding articles overtook that of the United States, making them #1 in the world (Appendix Figure 3).
- With the world trending the way it is, Japan has shown a very peculiar transition. While it has done fine in regard to the number of proceeding articles, preserving its #3 ranking behind the United States, it has leveled-off over the last 20 years in terms of periodicals, with its rank continuing to drop gradually (Appendix Figure 2, 3). With regard to articles per field, many dealt with electricity and few with information as Japan continues its divergence away from the rest of the world's research.
- The world's electrical, electronics, and information and communications-related research is polarized into three regions: North America, Europe, and East Asia (China, Taiwan, Korea, Japan, and Singapore). Japan, once an overwhelming #2 in the world for periodicals, is currently just one among East Asian countries.
- In Japan, universities take on a leading role in the production of literature, and substantial growth has been observed at universities in Japan. However, when examined by field, the number of fields has remained fixed for a long time, with Japan stuck on its own path, continuing its divergence away from the rest of the world. Also, only the amount of conference literature has been increasing rapidly. No growth trends have been observed as far as articles in periodicals are concerned. (Appendix Figure 3-5).
- An examination of the main companies producing literature reveals subjects like project reorganization and strategic international expansion of R&D. For example, Japan seeks information and communications research from overseas companies to make up for its own shortcomings in the field. The fear, however, is the fact that a source of new research fields and R&D has not materialized from within Japan.

2-2 International Mobility of Researchers (Presentation2)

Continuing on, analysis results on the international mobility of researchers were announced based on the reference material.[2] In the reference material,[2] international mobility of researchers was analyzed based on the home country/organization of researchers who have all three university degrees (undergraduate, graduate, and doctorate) and their relationship to organizations affiliated with the timing of the latest article presentations. The three fields chosen for analysis were "robotics," a next generation industry where application is expanding, "computer vision," which has given birth to a number of venture companies rooted in the research results of image recognition, and "electronic devices," a field of research that supports the electronics industry. From representative academic periodicals chosen for their large scientific impact on these three fields, historical data on articles and authors representing approximately 2,300 individuals per field for a total of 7,000 individuals was drawn up and a concrete international mobility shown.

- The field of robotics

  The majority of the world's universities, in addition to accepting researchers, are also sending them overseas in great numbers. In the other two fields, the accepting and supplying organizations were separate, but in this field, they were almost completely the same. In Japan, the number of researchers affiliated with the University of Tokyo was top in the world, though moves overseas have rarely been seen.
- The field of computer vision

  Chinese organizations provide a large number of researchers to the world. Tsinghua University and the Chinese Academy of Sciences are the typical examples. Also, universities and businesses are accepting overseas researchers. For universities, United States, United Kingdom, Singapore, and Hong Kong all stood out for their acceptance of overseas researchers. For businesses, Microsoft

accepted a great number of researchers who were educated overseas.

- The field of electronic devices

Besides universities, international research institutes and companies have been accepting many researchers. Typical examples of research institutions include IMEC (Belgium) and MINATEC (France). Typical examples of companies include NXP/ STMicroelectronics (Europe), TSMC (Taiwan), IBM (USA), and Samsung (Korea).

In Japan, there are many researchers at both companies and universities, but there is virtually no mobility. Also, while there are a large number of researchers affiliated with Japanese companies, the companies have not been accepting researchers educated overseas. Both international mobility and domestic mobility were low for Japanese universities (Appendix Figure 6-8).

- Overall characteristics of Japan

No matter the field, Japan exhibited little movement of researchers compared to other countries. Robotics and electronic devices are fields where Japan is highly competitive internationally, with the second most researchers after the United States, but the amount of movement taking place is low when compared to other countries. Japanese universities, when compared to major universities around the world, tend to be lower in terms of mobility between domestic organizations than is the case in other countries. Particularly in robotics, the number of researchers working at their alma mater is high (Appendix Figure 6-8).

3 Discussion (from the contents of the second half)

Below are the majority opinions taken from among all of the opinions raised during the discussion.

Presentation 1, which dealt with international competitiveness, showed that although the volume of conference article has been rising, the number of periodicals has remained stagnant for a long time. Company researchers appear to be transferring to universities to work on the same research they engaged in previously. Also, the specialization of university research into particular fields, couple with a lack of diversity, is viewed as problematic. Speculating on the main reason for all of this, fears have been raised that the fact that attendance of conferences is not translating into articles in periodicals means either that there is a decrease in quality at the research level, that researchers are unable to endure the mental strain of the article-creation process, or that researchers tend to present a Japanese article following the conference and end the process there. Additionally, it has been pointed out that phenomena that appears to be viewed as problematic in an engineering sense, also appears to be viewed as problematic in an economic sense. With regard to the lack of diversity seen in research activities, research subjects are fixed, and one opinion raised was that the isolated nature of universities might be part of the problem. There were also concerns for the future that the plateau in research could turn into a decline and pessimistic conjecture that the weakening of research activities could continue.

In presentation 2, which dealt with mobility, when compared to the increase in mobility of foreign countries, an active flow of researchers was not observed in any of the three fields in Japan, and the fact that researchers in all three fields tend to stay in Japanese organizations was viewed as problematic. As for a cause, it was mentioned that, at a time when researchers around the world started to move freely, only Japan was left behind. It was pointed out that, although there has been a trend around the world where a particular person triggers accelerated mobility among other researchers, that sort of thing has not happened in Japan.

A comprehensive look at both presentations suggested the following points as potential targets for study in the future.

● The need for a mechanism that ensures diversity

- A society without diversity cannot progress. Other advanced nations can cover for a lack of ability in engineering with their diversity. Therefore, there is a desire for a mechanism that ensures diversity.

● Changes are needed for Japanese scholarly societies

- Referencing the scholarly society of IEEE from an administrative/business-oriented perspective, some of the things the society does best include providing direction by way of ambitious goal setting and serving as a place for the exchange of ideas. Japanese scholarly societies need to change and adopting some of the things other societies do well might be a good start.

● The importance of providing meta-information

- Meta information mainly refers to “upping the

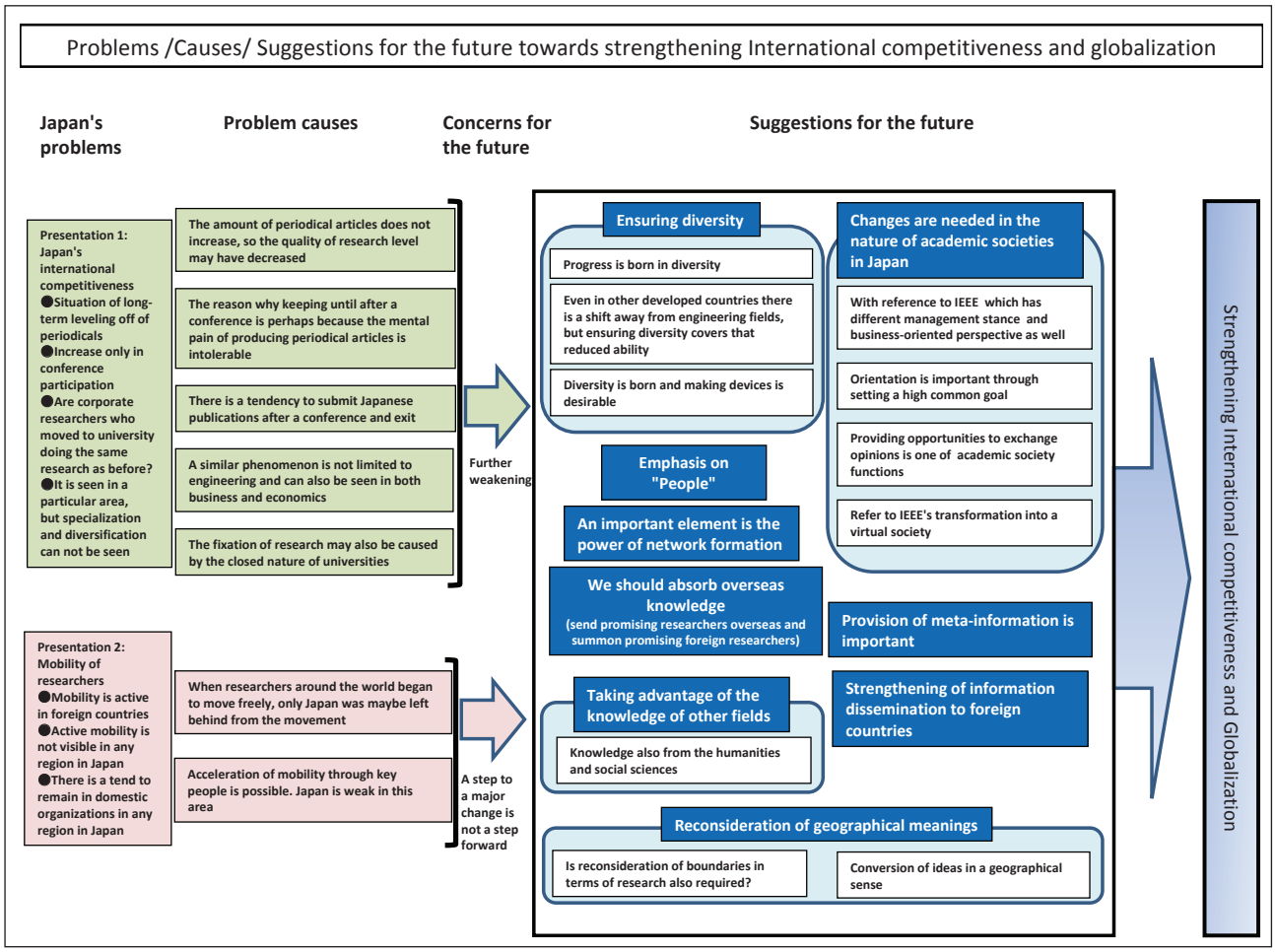


Figure 1 : Problems Causes, Concerns and Suggestions derived from opinions

appearance of the activities you're engaged in a notch as if in response to being watched by third parties" and "raising the level of abstraction of the significance/meaning of research results to make them more accessible to a greater number of individuals." When we are acutely aware of moving toward a period going through complex changes, this dispatch/provision is important for us to respond to these changes as quickly as they come. In particular, this sort of meta-information dispatch/provision needs to be among the changes made to scholarly societies.

● Stressing the importance of "people"

- In Japan, there is a lack of thought put into just how to use each individual person. It is important that Japan aim for development that is focused on the individual.

● Network creation an important factor

- If we improve/strengthen our networking, we may also be able to cover for Japan's current status as a country with low researcher mobility. In that case, creative abilities concerned with the way in which we construct networks will become increasingly important in the future.

● We should absorb foreign knowledge

- To absorb more foreign knowledge, we should send young and promising researchers overseas and also summon promising foreigners to Japan.

● Utilizing the wisdom of other fields

- We are gradually encountering large changes that cannot be solved by the fields of scientists and engineers alone (and will encounter more in the future). We should utilize the wisdom of experts versed in the humanities and social sciences to overcome these changes.

● In addition, opinions were raised that Japan may need to intensify its transmission of information overseas and reconsider its geographic significance.

The causes of problems, concerns, suggestions for the future, perspectives that should be taken seriously, and other contents relating to a variety of opinions raised in the discussion above have been compiled and are shown in Figure 1.

4 In Closing

A symposium was held based on "Globalization and the Intensification of Global Competition Seen in the IEEE." Through a discussion based on the contents of the concrete data that was presented, existing problems and their backgrounds were identified and perspectives on studies needed for future improvement were shown (Figure 1). However, there are limits to these in the forms of limited sources of information and a limited number of participants from which to draw opinions. In the future, I believe that these perspectives will need to be scrutinized, missing perspectives provided for, and studies dug into deeper. I also believe more discussion on concrete proposals is needed. It is my hope that the materials I have provided here will be of help to future studies.

Acknowledgments

Starting with President Fumio Harashima of Tokyo Metropolitan University, Professor Kiyonori Sakakibara of Hosei Graduate School of Innovation Management at Hosei University, Professor Hiroyuki Chuma of the Hitotsubashi Institute of Innovation, and Associate Professor Atsushi Sunami of the National Graduate Institute for Policy Studies for graciously agreeing to serve as commentators during the symposium, I would like to express my profound gratitude to all participants who presented invaluable opinions and comments and took time out from their busy schedules to attend and contribute to this symposium.

Appendix: Discussion Contents

The contents of the symposium's discussion are shown below. This section is divided into opinions concerning the causes of problems, concerns for the future, and suggestions for the future, among other things, and combines similar opinions to display them as one. Furthermore, with regard to each individual opinion, the exact expressions used were maintained whenever possible, though, on the other hand, summaries use focused expressions to capture the gist of the argument.

A) Discussion based on presentation 1: "Japan and Trends in World Research"

(1)Identification of problem areas

Figures 2-5 below were the primary focus of the discussion.

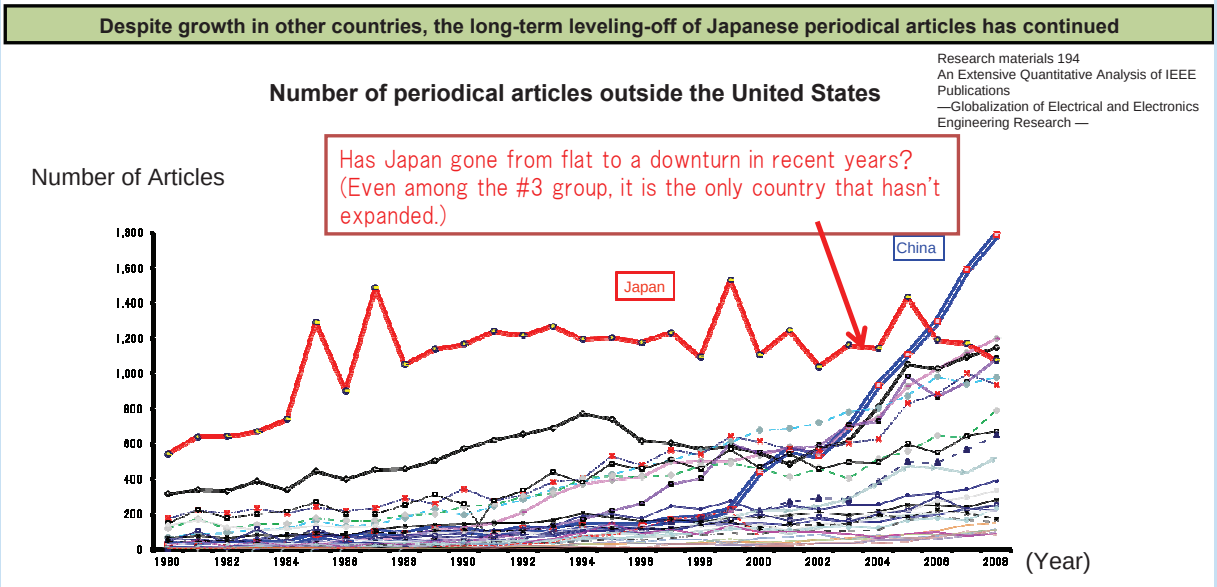


Figure 2 : Long-term leveling off in terms of periodical articles

From Presentation 1/Reference[3]

(2) Discussion issues

The discussion focused on the following issues

1. Long-term leveling off and research field bias has been observed in Japan's engineering R&D. What will happen if things continue like this unabated?
2. Are there other fields/areas where long-term leveling off and field bias has been observed outside of engineering? Or are similar trends occurring outside of R&D?
3. Is the research pattern of Japanese engineering researchers (particularly researchers at universities) on the right track?
4. Assuming there is something concrete that can be done to improve the situation in the future, what do you think that would be?

Shown below is a summary of the opinions raised based on issues 1-4. (Descriptions do not deal with each discussion issue).

The growth in the number of conference articles matches worldwide trends

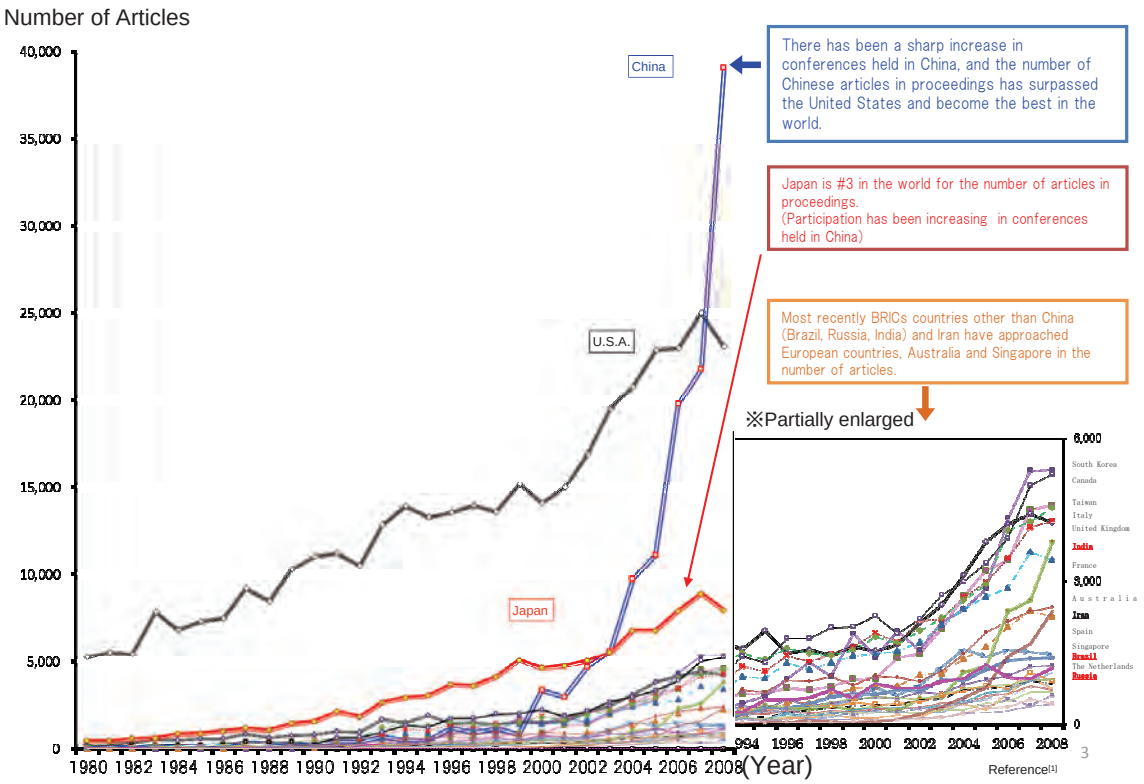


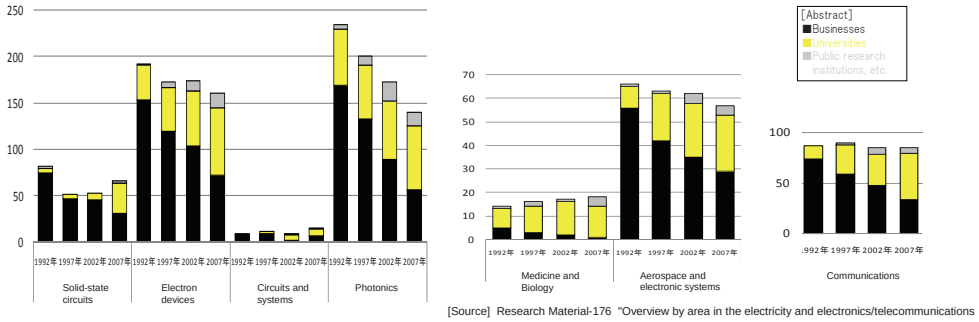
Figure 3 : The growth in the number of Conference articles

From Presentation 1/Reference[3]

Domestic human mobility in Japan from industry to academia has happened, but even if the leader of the periodical production changes, little change can be seen in the contents of the research.

There are fields where corporate researchers have moved to universities and it seems like they have continued the same research

Transition in the number of periodical produced by different sectors in Japan (1992, 1997, 2002, 2007)



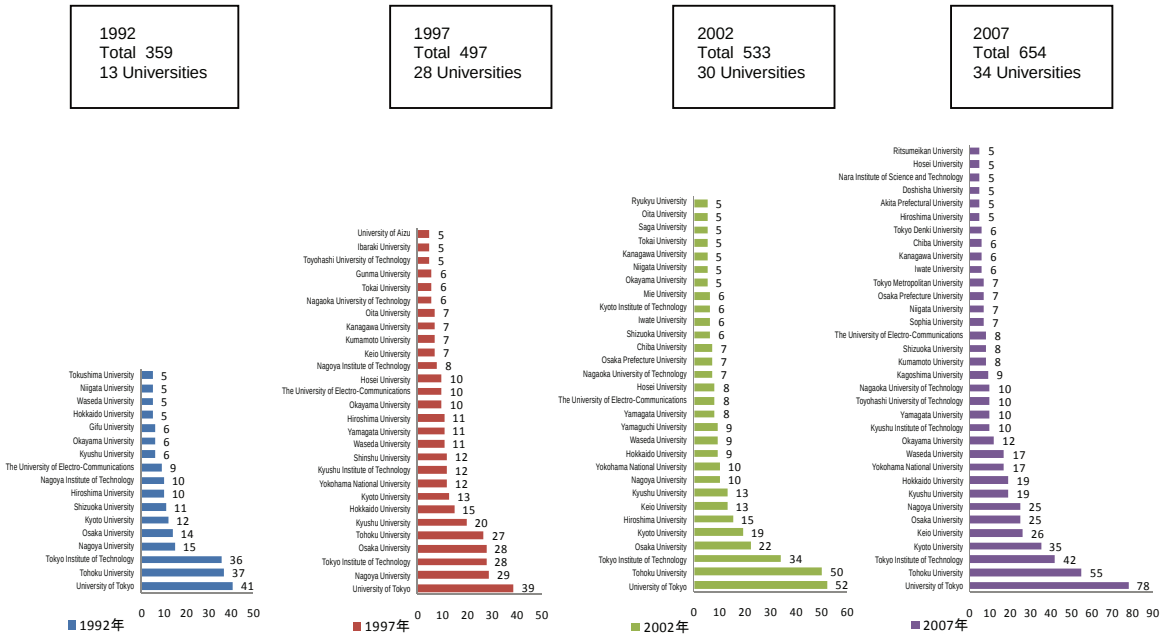
[Source] Research Material-176 "Overview by area in the electricity and electronics/telecommunications fields"

Figure 4 : Replacement of major player in the periodical production and Change of the contents of research

From Presentation 1/Reference[3]

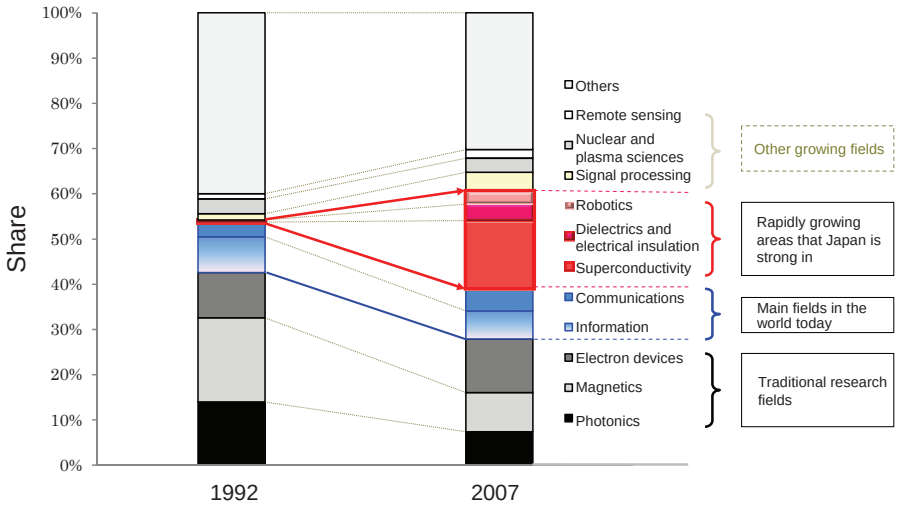
There have been developments in quantitative terms, but on the other hand, diversity has not been seen in university research

- The number of universities producing periodical articles has increased



The number of periodical articles from universities that produced more than five periodical articles

- Reference construction for different research fields in universities
  - On the whole there has been a trend to specialize in a particular field such as superconductivity, but the appearance of diversity of research fields has not been observed.



[Source] Trends in Science and Technology, October 2010 "Changes in research activities in the electricity and electronic, and Information and communication fields in Japan" http://www.nistep.go.jp/achiev/ftx/jpn/stfc/stt115j/report2.pdf

Figure 5 : Growth in the number of Universities producing periodical articles and trends for specialization in a particular field

From Presentation 1/Reference[3]

(3) Majority opinions concerning the causes of problems

● Electronic conversion, the elimination of the Eastern Bloc, and holding with low-price in China are seen behind the large number of conferences

- Due to the Internet and the process of electronic conversion, holding a conference has become exceeding easy. This trend has also been backed by the increased affordability of airfare, and the fact that the end of the Eastern Bloc has allowed individuals to move much more freely. Finally, the IEEE has been placing importance on conferences that offer high profitability. The reason that there are so many conferences in China might be because they are more profitable, even if membership fees remain the same.

● On whether the lack of increase in Japanese periodical articles is because of a decline in the level of research

- The field of electrical and electronic information has long been on the decline in Japan. The first and foremost cause for this decline is a shift away from engineering, with most of the people in the field already over 40 years of age. While the leaders in this field who are pushing 50 or 60 years old are still highly regarded, there is concern that the quality level of researchers who are researching now has been on the decline. The problem might not be that they are not writing articles but that they cannot write them.

● On whether the halt in action following conferences is a result of the mental strain of the scholarly article process

- Could there perhaps be an increase in the number of researchers unable to endure the mental strain of the process of publishing an article in a periodical following a conference? When an article is written after a conference, it leads to harsh peer reviews and extensive exchanges of information. Moreover, unlike in the past, the Internet makes that exchange process infinitely faster. There is a sense that there are researchers unable to handle this degree of mental strain. The thinking is that it does not necessarily mean a decline in research abilities.

● There is a trend toward ending the process by submitting an article to a Japanese periodical after a conference

- It was pointed out that a reason that there might be an increase in conference appearances without an increase in English articles in periodicals could be that a number of researchers in these fields present their material at international conferences and then go on to only submit their articles to Japanese language periodicals.

● Similar phenomena are not limited to engineering research but are being observed in business and economics as well

- Even with semiconductors, a shift has taken place from customized parts known as ASIC to dual-purpose items like ASSP and FPGA, and this shift will change society in a variety of ways but can easily go unnoticed. In the field of business as well, it is often hard to find the courage to take the next step. Similar phenomena are not limited to just engineering R&D but are being observed all over.
- Certain organizational limits that we have confronted are almost completely like fractal structures to the extent that they cannot be overcome and are phenomena that not only appear in scholarship but in business as well. Phenomena similar to these have even been observed in economics.
- Could there be a cause that goes deeper than just engineering or R&D? It could perhaps have something to do with the characteristics of Japanese citizens.

● On whether the isolated nature of universities is part of the reason for fixed research subjects

- One reason why it is hard for the research subjects in Japan to change could be the isolated nature of universities. For example, if the same professor is at one university for a long time, the subject of his or her research might not change in 20 years. Also, the transfer of researchers to come to universities from companies is viewed positively, but if the former head of a research division at a company comes to a university, the research subject he/she teaches could lead to talk of the past and possibly lower the level of the university in some cases.

● The degeneration of organizations lacking in diversity

- The main cause is a lack of diversity. Without diversity, organizations degenerate. Groups that do not understand diversity and do not respect it are doomed to degenerate.

(4) Another perspective on the background of these problems

● This leveling off may have something to do with pioneering efforts in other fields

- Is the leveling off really a bad thing? If you look at the activities of teachers who hate to get caught up in one field, the number of articles submitted to existing fields by top teachers might be decreasing as those teachers work with students to write the articles necessary to pioneer other fields. Also, it appears that a significant part of their work does not translate into scholarly articles. Accordingly, it is not understood whether or not the decline in the sharing of articles in traditional fields is really a bad thing.

(5) Opinions concerned with fears for the future.

● It is feared that if things continue as is, Japan might not only continue to level off but might actually start to weaken further.

(6) Opinions concerned with suggestions for the future

● The emergence of progress from diversity

- It is impossible for a society without diversity to progress. Progress that occurs within a state of Galapagos Syndrome is not really progress.

● Other developed countries have seen a shift away from engineering but are covering for their decline in abilities by preserving diversity

- A shift away from engineering has also been occurring in other developed countries. For example, even if there are promising individuals at universities in the United States, you will rarely meet one who was born in the United States. However, even this is strong overall and a direct effect of diversity.
- In the case of other developed countries, they cover drops in ability with diversity, and by doing so, attain further diversity and the added value and abilities that come with it.

● Desire for the creation of mechanisms that will breed diversity

- It is important to come up with mechanisms that will naturally produce diversity. These mechanisms should be concerned with the presence of diversity at universities, how to stimulate governance, knowing how the world is trending, what moves result in money, and how to gather people together. It is necessary for Japan to show a bit of success with some of these.

● That we should absorb foreign knowledge (send young and promising researchers overseas and summon promising foreign researchers to Japan)

- About 30 years ago, Korea acted to send all of its science and technology university teachers on yearlong study abroad trips to the United States, Japan, or Europe. The result of that was rapid development due to the foreign research subjects they brought back with them to Korea. In this way, a compulsory measure that sends researchers overseas for a year could do nothing but help. If you send as many young and promising researchers as possible overseas, the activities they engage in there should be considered good even if they opt not to return to Japan. Also, in order to educate Japan's young, we need to summon promising individuals from overseas. Are ideas like this not a good place to start?
- We should not do anything unreasonable to force Japanese university students into engineering departments. It is thought that the promising individuals we really need should just be summoned from overseas. Japan is the only developed country that has not done that, and it is thought to be part of the reason for the country's slump.

● We should break deadlocks by converting to a more positive way of thinking

- Once, the majority of home appliances were invented in the United States, then taken and changed by Japanese companies. Now Korea, Taiwan, and China are all doing the same things to Japan. Instead of lamenting, now is the time for us to come up with the next industry or innovation.

B) Discussion based on Presentation 2: "International Mobility of Researchers"

(1) Identification of problem areas

Figures 6-8 below were the primary focus of the discussion.

(2) Discussion issues

The discussion focused on the following issues

1. What kind of influence has the international mobility of researchers on the whole of Japanese R&D?
2. What form does the influence of international mobility of researchers take in each organization's R&D? What becomes of the organization as a result of that?
3. East Asia represents one of the world's three engineering pillars. What should Japan's global personnel development strategy be with regard to future Asian expansion?
4. For a Japanese industry heading toward globalization, what level of international experience is necessary for research personnel enrolled in university or graduate school?

The discussion for issue 1 was quite lively while few opinions were raised for issues 2-4.

(3) Opinions supporting the correlation between mobility and diversity

● At a time when the world's researchers started to move freely, only Japan seemed to be left behind

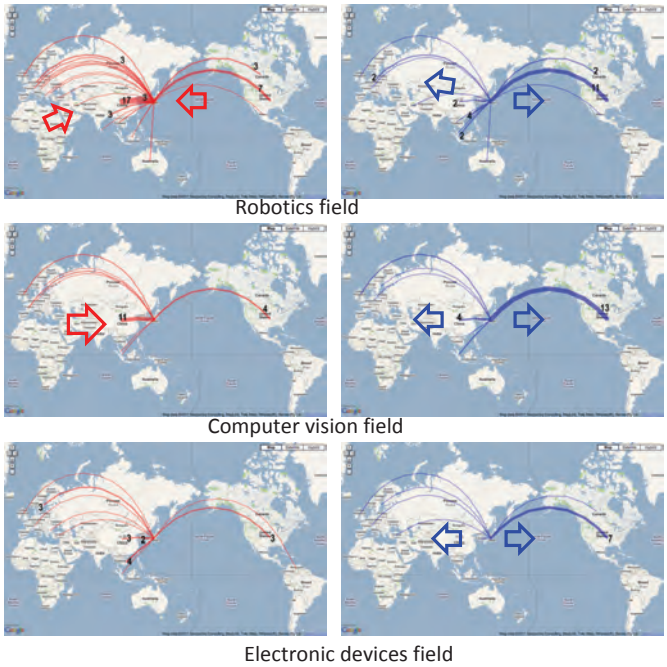
- Following the collapse of the Eastern Bloc in 1990, when the world's researchers started to move about freely, it is said that Japan was the only country left behind in that movement. Excluding Japan, discussions among an extremely diverse world community were occurring on every topic from how to engage in research to the establishment of research subjects.
- Modern civilization has reached a mutual understanding over differing value systems, and through mutual respect, is making a move to discover its next value system from within. Accordingly, diversity is a necessary condition for progress. Modern Japan really needs it as well.

● On whether a key individual is often one of the aspects in accelerating researcher mobility and if Japan is weak in that regard.

- For example, in the field of electronic devices, Taiwan and Korea had a lot of momentum between 2008 and 2009, but more time is needed to tell whether or not they will continue to change dynamically. For example, in the case of Singapore, a researcher transferred from a United States university and brought a great number of people with him/her. Korea and Taiwan, having had similar experiences, made good connections, and their ability exchange research information on the international level reached historic heights. It should be understood that today's figures are a result of that background. We should look more carefully at what causes these kinds of cycles.
- Currently, there is a lot of attention on Saigon in Vietnam. A key individual who earned lot of experience in Silicon Valley has returned, and it seems like things may start to change from here on out. Japan does not lack volume; it lacks a star player. Maybe there is some reason why Japan is unable to produce such a person.
- Japan still gives off the impression of some degree of volume. However, Japan gives off a sense of volume but it lacks that starring individual. Compared to countries and organizations that have low volume but cast a large shadow due to the presence of a key individual, Japan seems bloated by comparison.

No matter the research field, active mobility has not been observed

Movement patterns of Japanese researchers by field



- Active mobility has not been seen in any field.
- Even in fields where there are many researchers in Japan like the robotics field and electronic devices field, there is not a lot of mobility compared to other countries.

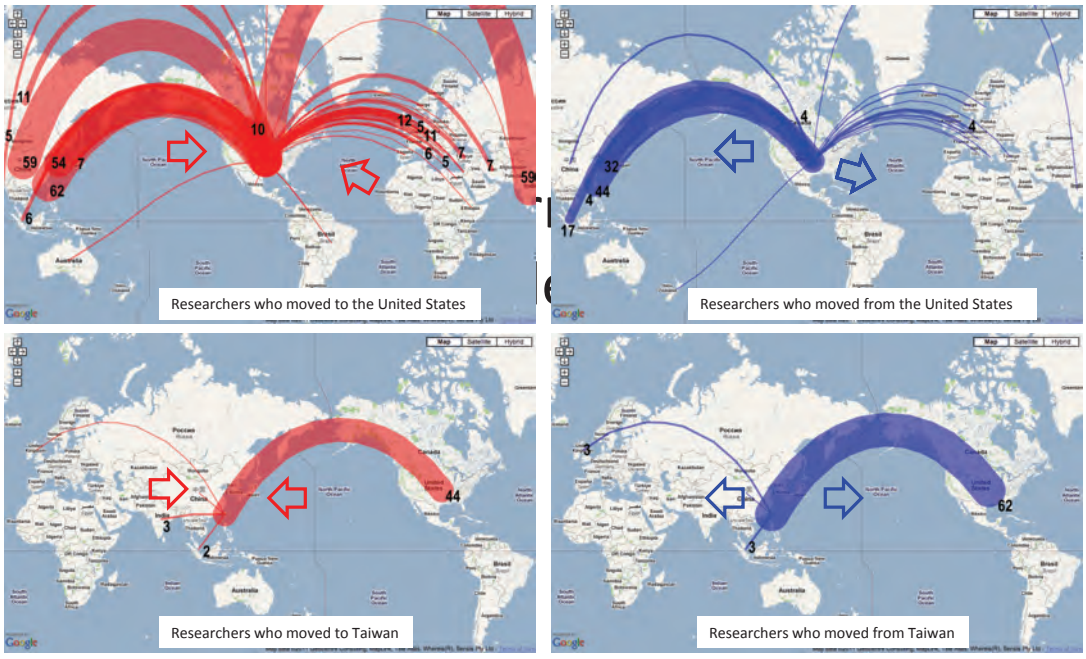
Line thickness shows the number of researchers moving internationally.

Figure 6 : Movement patterns of Japanese reseachers

From Presentation 2/Reference[4]

Mobility in foreign countries is very active

Movement patterns of researchers (Electronic devices field)



Line thickness shows the number of researchers moving internationally.

Figure 7 : Movement patterns of foreign researchers (Electronic device field)

From Presentation 2/Reference[4]

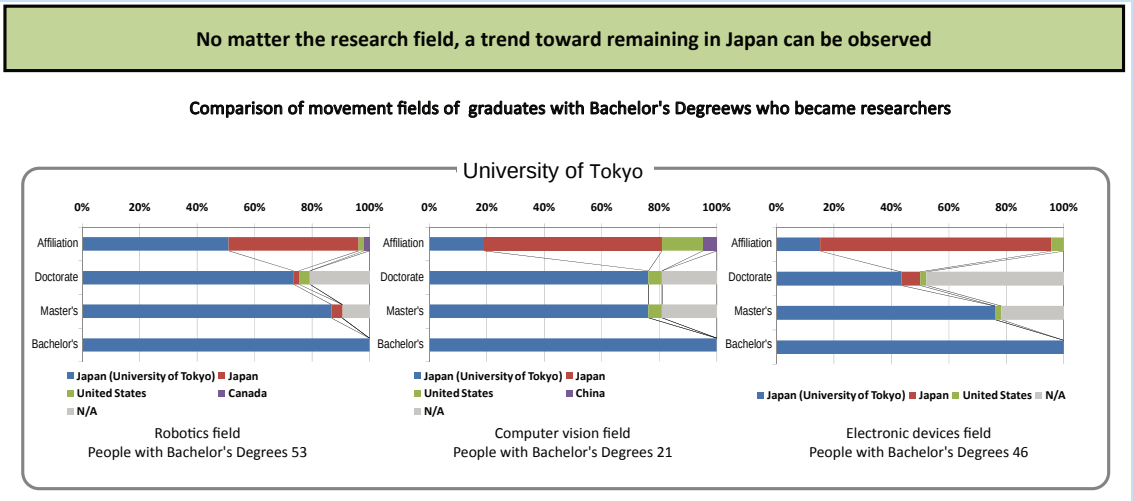


Figure 8 : Trajectories of Japanese reseachers who graduated from the University of Tokyo
From Presentation 2/Reference[4]

(4) Opinions doubting the correlation between mobility and diversity

● Measuring mobility by frequency

- Can the meaning of high international mobility, including how it occurs, be discussed just by looking at frequency?
- Even China and Hong Kong's original social systems have been based on international mobility. A separate discussion is necessary for R&D.

● You cannot just say that because mobility is high that diversity is high

- Can you clearly say that if mobility is high, diversity is also high? There has been talk that people who have experience moving between organizations or people who are especially mobile boast fewer achievements than those who do not move. Rather, it is thought that a stereotypical pattern persists where that sort of movement pattern represents some sort of a rut, and researchers like this just move from companies to universities after actively engaging in research and attaining senior status.
- In regard to countries with high researcher mobility, there is a need for us to carefully examine what specific changes occurred that changed them from a state of low mobility to high mobility as well as what effect that change had on their competitive powers. Perhaps, based on the conditions for high mobility possessed by those countries from the start, we should also examine whether or not something else is occurring to cause this.
- The phenomenon of a single snapshot of short-term international mobility is not worth discussing. There are cases where something is implemented, a community develops in the area it was started, and then after 10 or 20 years, some sort of dynamism emerges.

(5) Fears of what could occur in the future

● That Japan will not take the first step toward real change

-In the field of semiconductor devices, exceeding a certain density can cause revolutionary changes, and the innovative abilities of a period can expand greatly in a non-linear fashion. If Japan cannot find such a "potential change of circumstances", is it not nearly impossible for Japan to progress to the next stage?

(6) Suggestions for the future

● Making network formation into an important factor

- Network externality is strong with electronics and telecommunication products. It is also important in their R&D. If the ring of this trend continues to expand and eventually hits critical mass somewhere, does it not bring about an instant increase in benefit? This is not a regional problem. It is the process through which the network is formed that is important, and it feels as if Japan has been left behind in this regard.
- If there is a way to improve networking outside of mobility, could strengthening it allow us to cover for our current circumstances?
- When some sort of network externality appears and a network is formed within that world, entire trends actually gravitate as if they are being pulled by the effect of that network. The exchange of meta-information is extremely effective in improving networking (see Note 2 below).

Note 1: The speaker, with regard to the R&D "network externality" in this discussion, is not only referring to the networking of products that resulted from R&D. If an R&D organization networks, it can give birth to dominant competitive power. Namely, this is to be recognized for having produced the de facto standard.

● The wisdom of the humanities and social sciences

- Shortly, a number of Japanese industries may encounter a "potential change of circumstances" that requires them to listen to the wisdom of individuals versed in the humanities and social sciences in addition to scientists and engineers. I wonder if the history we have been facing up until now is the drop in competitive power that will bring us to that stage.

● The need to reconsider research boundaries

- Do you think that Japanese boundaries can be thought of simply in terms of what is on this island? For example, in 2001, Microsoft created a research institute in Beijing, and a number of Japanese researchers transferred there. There, a research environment similar to the ones in Japan was created and, despite its location in China, Japanese researchers conduct research in the same way Japanese researchers conduct research back in Japan. This small part of China has been brought closer to Japan. Research can be conducted freely, and a number of Japanese students are conducting a variety of research and engaging in discussions there.

C) Discussion regarding opinions that deserve a closer look

(1) Discussion issues

1. If you assume that there are factors beyond personnel mobility that are greatly impacting Japanese R&D, what do you think they are?
2. What kinds of strategies come to mind in terms of global personnel development at various centers/ organizations?
3. Is some sort of numeric goal necessary? If you think it is necessary, where and how should we establish this goal?

The discussion primarily focused on issues 1 and 2, while almost no opinions were raised regarding issue 3.

(2) Opinions presented

● IEEE, which differs from Japanese scholarly societies in its basic administration and also possesses a business-oriented perspective

- The roles of Japanese scholarly societies are simply limited to transactions and conferences. On the other

hand, IEEE simultaneously functions as a union to some degree, helping electrical/electronic engineers search for jobs or transfer. This part in particular seems to be lacking in Japan.

- IEEE is an NPO and thinks of its existence on its own. In other words, it is constantly asking itself, "who is your customer?" For that reason, the publishing of materials that can be read and understood by normal people is fundamental. By being customer-oriented in this way, they can function to some degree in a business-oriented sense as well. Japanese scholarly societies need the same thing. If they do not develop it, can they continue to function?
- They cannot receive donations from particular companies. They are prohibited from providing profits to any standards or anything else. In Japan as well, scholarly society management styles should add features that are now common practice around the world like IEEE.

● The ability of scholarly societies to provide a place for the exchange of ideas

- IEEE Computer Society is a scholarly society with as many as 200,000 affiliated members, and with branches in each country, it has been providing places where people can gather to exchange ideas.

● The importance of guidance through the setting of common goals

- In the United States, there is the extremely simple goal of trying to be the best in the world, and scholarly societies have been working as professional societies for the purpose of that sort of education or goal.
- In the past example of the applied physics in Japan, a number of researchers from a variety of fields got together and made it their goal to beat the United States, particularly, to beat Bell Labs, the best in the United States at that time. Under a common goal, they were able to get the technological best out of the whole of Japan, and working with the common purpose of surpassing the United States, were actually able to do it temporarily. If you aim low with the goal you set, you will never achieve anything higher than that level. It is important for scholarly societies to make it their goal to be the best, and if they do, I expect that they will work extremely well as professional societies.

● IEEE's transformation into a virtual society

- A network-based virtual society has been constructed at IEEE. In the future, it will develop in the capacity of a 2-dimensional organization structure.

● The importance of providing meta-information

- At IEEE, a real commitment is made toward standardization activities, and the scholarly society performs its roles in a variety of forms. Through those activities, it is thought that we need to be better able to see the parts we are doing ourselves in a more "meta" way. If we lack such meta-information, we tend to stubbornly adhere to the same results. We should discuss how to provide meta-information.
- The magazine Spectrum and American Physical Society's weekly review have been reporting on trends in a form that is accessible to even novices. Is it not necessary for meta-information to be reported in this fashion for people who are not researchers? If that sort of avenue does not exist, scientific techniques cannot be discussed within social science research. Looking for that sort of thing in Japan is no small task.
- The speed of change will not increase unless you report what is happening in the form of meta-information.

Note 2: By "meta-information," the speaker is referring to "the abstract perspective of upping the appearance of the activities you're engaged in a notch as if in response to being watched by third parties" and "raising the level of abstraction of the significance/meaning of research results to make them more accessible to a greater number of individuals."

● The importance of "people"

- Japan's biggest problem is that it lacks the concept of what to do with each and every one of its "people." The focus of attention overseas is fundamentally on "people." In even the case of mergers and acquisitions, it is not just about profit. It is considered effective because the "people" move together. Japan does not really have that kind of concept. In particular, teamwork is an extremely weak point of Japanese universities and graduate schools. "People" are the ones who actually conduct R&D.
- Currently, there is a lot of attention on Saigon in Vietnam. A key individual who earned lot of experience in Silicon Valley has returned, and it seems like things may start to change from here on out. Japan lacks the movement of this sort of star player. The problem has to do with why Japan is unable to do this and what the reason behind this inability might be.
- Japan still gives off the impression of some degree of volume. However, it lacks that "star person."

● Enhancing information transmission to countries overseas

- More efforts need to be made toward transmitting information abroad or accurately receiving information in Japan.

● A change in thinking based on the geographic significance of Japan's location

- Japan personally thinks itself to exist in a remote area. There are reasons that Japan is strong that are expressly related to its remote location, but the fact that we are not putting forth the effort to capitalize on

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Profile

Minoru Nomura
Affiliated Fellow
Science and Technology Foresight Center
http://www.nistep.go.jp/index-j.html

Received his present post after working at companies in R&D of CAD for computer design, the field of high performance computing, and business development for the field of ubiquitous computing. He is interested in the science and technology trends of supercomputers, LSI design technology, etc. Currently, he is conducting research into "science of science and innovation policy" and is striving for the quantification/visualization of social/economic results of R&D.

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